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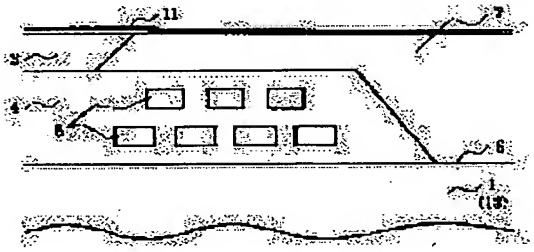
(54) PERPENDICULAR MAGNETIC RECORDING TYPE THIN-FILM MAGNETIC HEAD

(57)Abstract:
PURPOSE: To form a magnetic films for poles on a good and smooth surface and to obtain a magnetic head having high reliability by forming the pole film on the magnetic film of a very small film thickness formed on cores and embedded insulating layer.
CONSTITUTION: After the nonmagnetic insulating layer consisting of SiO2, Al2O3, etc., is formed by sputtering on a magnetic substrate 1, a coil conductor 5 consisting of Cr/Cu/Cr (Cr: joint surface) is formed with the coil insulator and thereafter, core connecting through-holes 6 are formed. The film of a Co-Ta-Zr based amorphous allay is formed by sputtering and is patterned to form the magnetic cores 7 and thereafter, the film of a nonmagnetic insulating material 3 of forsterite, etc., is formed by sputtering. The insulating layer 3 is so flattened as to remain on the cores by lapping for flattening by mechanical polishing and etch back, etc., by ion etching and further, the nonmagnetic insulating layers of the very small film thickness on the cores are removed. The magnetic film for poles is then formed by sputtering, etc., and is patterned to form the poles.



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[Date of final disposal for application]

[Patent number]
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[Number of appeal against examiner's decision of rejection]
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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the vertical-magnetic-recording mold thin film magnetic head which came to carry out the laminating of a coil, a magnetic core, and the pole magnetic film one by one, and has combined said magnetic core with the magnetic substrate and the magnetic target in the core connection a magnetic substrate top -- an insulating layer -- minding -- a conductor -- Membranes are formed on the nonmagnetic insulating layer on the nonmagnetic insulating layer which is embedding said magnetic core and magnetic core, and this pole magnetic film minds this nonmagnetic insulating layer on a magnetic core. Or the vertical-magnetic-recording mold thin film magnetic head characterized by having connected with a magnetic core and a magnetic target in the through hole part formed on the magnetic core.
[Claim 2] It comes to carry out the laminating of a coil and the magnetic core one by one. a magnetic substrate top -- an insulating layer -- minding -- a conductor -- In the vertical-magnetic-recording mold thin film magnetic head which it was formed in the vertical magnetic substrate cross section, turned embedded flattening of said pole magnetic film to said magnetic substrate up by the nonmagnetic insulating layer after magnetic film formation for connection, and is formed said magnetic core -- a core connection -- a magnetic substrate and a magnetic target -- joining together -- a pole magnetic film -- a magnetic core and abbreviation -- Membranes are formed on the nonmagnetic insulating layer on the nonmagnetic insulating layer which is embedding said magnetic core for connection and magnetic core, and this nonmagnetic insulating layer is minded on a magnetic core. Or the vertical-magnetic-recording mold thin film magnetic head characterized by having connected with a magnetic core and a magnetic target in the through hole part formed on the magnetic core.
[Claim 3] In the thin film vertical magnetic head which has the pole formed with the coil / magnetic-core structure, and the thin film which come to carry out the laminating of a coil and the magnetic core one by one the magnetic film top on a magnetic substrate or a substrate -- an insulating layer -- minding -- a conductor -- Said pole section forms the magnetic layer for the poles to the smooth side which embedded the magnetic film in the slot established in the nonmagnetic insulating substrate. In the vertical-magnetic-recording mold thin film magnetic head formed by pasting a coil / magnetic-core structure after carrying out patterning and being formed separately This pole magnetic film is the vertical-magnetic-recording mold thin film magnetic head characterized by forming membranes on the magnetic layer on the nonmagnetic insulating substrate embedding the magnetic film embedded at said nonmagnetic insulating substrate, and a magnetic film, and forming the pole point in the through hole part on a nonmagnetic insulating substrate.
[Claim 4] In the thin film vertical magnetic head which has the pole formed with the coil / magnetic-core structure, and the thin film which come to carry out the laminating of a coil and the magnetic core one by one the magnetic film top on a magnetic substrate or a substrate -- an insulating layer -- minding -- a conductor -- Said pole section forms the magnetic layer for the poles to the smooth side which embedded the nonmagnetic insulator layer in the slot established in the magnetic substrate. In the vertical-magnetic-recording mold thin film magnetic head formed by pasting a coil / magnetic-core structure after carrying out patterning and being formed separately Membranes are formed on the nonmagnetic insulating layer on the magnetic substrate which is embedding the nonmagnetic insulator layer embedded at said magnetic

substrate, and the nonmagnetic insulator layer, and this pole magnetic film minds this nonmagnetic insulating layer on a magnetic substrate. Or the vertical-magnetic-recording mold thin film magnetic head characterized by having connected with a magnetic substrate and a magnetic target in the through hole part formed on the magnetic substrate.
[Claim 5] The vertical-magnetic-recording mold thin film magnetic head according to claim 1, 2, or 4 to which the taper angle of the through hole formed in the nonmagnetic insulating layer on the Sulu hall formed in the nonmagnetic insulating layer on the magnetic core which forms the pole, or a magnetic substrate is characterized by 30 degrees or less of a certain things.
[Claim 6] The vertical-magnetic-recording mold thin film magnetic head according to claim 1, 2, 4, or 5 characterized by the thickness of the nonmagnetic insulating layer on the magnetic core which forms the pole being 1 micrometer or less.
[Claim 7] The vertical-magnetic-recording mold thin film magnetic head according to claim 3 to which the taper angle of the through hole formed in the Sulu hall formed in the magnetic layer on the nonmagnetic insulating substrate which forms the pole is characterized by 30 degrees or less of a certain things.
[Claim 8] The vertical-magnetic-recording mold thin film magnetic head according to claim 3 or 7 characterized by the thickness of the magnetic layer on the nonmagnetic insulating substrate which forms the pole being 1 micrometer or less.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is a **** thing at the thin film magnetic head for high density magnetic-recording playback.
[0002]
[Description of the Prior Art] Conventionally, although field inboard magnetization has been used in the field of magnetic recording, while advancing densification in recent years, the vertical-magnetic-recording technique perpendicularly magnetized to a medium side is progressing quickly.
[0003] As the vertical magnetic head, it is TV institute magazine. Vol.39 and No.4 (1985) The method of pasting up the chip of the main pole which was reported variously, got down as shown, and sandwiched the high permeability film at the head of a ferrite as the formation approach of the main pole is proposed. As a method, the method which arranges the main pole and an auxiliary magnetic pole, and the main pole excitation mold which can access only from a main pole side are in medium both sides. Although the method which arranges an auxiliary magnetic pole at the medium rear face is the structure which was suitable for record playback at vertical magnetization, it is weak in an external noise, and it has troubles, like a system configuration becomes complicated, and the research on these points to a main pole excitation mold is active.
[0004] On the other hand, the minuteness of a head and the vertical-magnetic-recording mold thin film magnetic head which can attain lightweight-ization are having the conductor layer 5 which forms a coil layer up and down on both sides of an insulating layer 4 on the magnetic substrate 1 as are shown to the Japanese opportunity institute (NO.930-45) and shown in drawing 24 , and structure which carried out the laminating of a magnetic core 7 and the main pole magnetic layer 11 one by one further. Journal ofMagnetics of Japan Vol.15 Supplemeent and No.S2 (1991) a conductor as are shown and shown in drawing 25 -- the core of the coil of a coil 5 -- a magnetic core 7 and a magnetic core, and abbreviation -- the thin film magnetic head of the structure which forms the main pole magnetic layer 11 to a vertical field, and is formed in it is proposed. [on the other hand,] If two plane structures as shown in drawing 25 are taken, compared with the case of the planar structure of drawing 24 , the height of a head component can be made small.
[0005]
[Problem(s) to be Solved by the Invention] The thin film magnetic head can attain the minuteness of a head, and lightweight-ization, and two plane structures of the above-mentioned magnetic core/main pole are dominance at the point which can make head component height small. However, in a pole formation process, although it was possible to have formed the pole film on a smooth side case [whose relation between the pole and a core is / like drawing 26], there was a problem that the pole film received breakage, at the time of up core patterning. Moreover, in order to form the pole film on the level difference of a core case [like drawing 27], the problem was in the thickness in the level difference section, and the dependability of membraneous quality. Furthermore, when structure as shown in drawing 28 is taken, large spacing of the main pole and an auxiliary magnetic pole can be taken, there is also no membrane formation of a up to [the level difference of a core], there is no breakage on the pole pattern by etching of a core etc., but according to the membraneous quality of the insulating layer of the

boundary parts of a core pattern and an embedded insulating layer and the partial wear of the core material at the time of smoothing, and an insulating material, the difference of an etching rate, etc., though minute in a core / insulating interface section, a level difference is produced. On the other hand, since the thickness of the pole film which forms membranes in the upper layer is very thin (- 0.3 micrometers), it will be influenced by the minute level difference, and it caused breakage on the pole, and the problem was in the yield and dependability.
[0006] The object of this invention is in pole film formation of the thin film vertical magnetic head as for which minuteness [of a head], lightweight-izing, and head component height is made to min to offer dependability and the thin film vertical magnetic head which obtains improvement in a yield.
[0007]
[Means for Solving the Problem] The above-mentioned object is attained by forming the pole film on the magnetic film of the minute thickness which connected with the core in the through hole part which formed the pole part of the vertical-magnetic-recording mold thin film magnetic head on the insulating layer of the minute thickness formed on the core and the embedded insulating layer, and was formed on the core, or was formed on the core and the embedded insulating layer.

[0008]
[Function] The pole film of the thin film vertical magnetic head is formed on the insulating layer of the minute thickness formed on the core and the embedded insulating layer. By forming the pole film on the magnetic film of the minute thickness which connected with the core in the through hole part formed on the core, or was formed on the core and the embedded insulating layer Since the upper insulating layer or a magnetic layer covers the level difference of the core / insulating interface section by the membraneous quality of the insulating layer of a core / insulating material boundary and the partial wear of the core material at the time of smoothing, and an insulating material, the difference of an etching rate, etc., The magnetic film for the poles can be formed to a good smooth side, and dependability and the high vertical-magnetic-recording mold thin film magnetic head of a yield can be offered.
[0009]
[Example] Hereafter, the 1st example of this invention is explained using a drawing.
[0010] the top view and drawing 2 which show an example of the thin film magnetic head according [drawing 1] to this invention -- the A-A' sectional view of drawing 1 -- it is -- 1 -- a magnetic substrate and 2 -- for a signal coil and 7, as for the main pole and 8, a magnetic core and 11 are [a nonmagnetic insulating substrate and 4 / a signal coil insulation layer and 5 / a protective coat and 13] auxiliary magnetic poles.
[0011] The Mn-Zn ferrite substrate is used for the magnetic substrate 1 in this example. The Co-Ta-Zr system amorphous alloy is formed in magnetic-core material by sputtering etc. The signal coil forms Cu by vacuum evaporationo etc. by making Cr into a junctional zone. Forsterite is formed in a protective coat by sputtering, vacuum evaporationo, etc.
[0012] Hereafter, the production process of the thin film magnetic head by this invention is met and explained to drawing 3 - drawing 8 .
[0013] (drawing 3) the coil which consists of Cr/Cu/Cr (Cr; junctional zone) after forming the nonmagnetic insulating layer of SiO2 and aluminum2O3 grade by sputtering etc. to the magnetic substrate 1 -- form the core connection through hole 6 after forming a conductor 5 through a coil insulation layer.
[0014] (Drawing 4) By sputtering etc., form membranes, carry out patterning of the Co-Ta-Zr system amorphous alloy, and form a magnetic core 7.
[0015] (Drawing 5) Form nonmagnetic insulating materials, such as forsterite, by a spatter etc.
[0016] (Drawing 6) With the flattening lap by mechanical polish, the etchback by ion etching, etc., carry out flattening so that an insulating layer may remain on a core.
[0017] (Drawing 7) Remove the nonmagnetic insulating layer of the minute thickness on a core.
[0018] At this time, if it forms so that the angle theta which a nonmagnetic insulating layer and a magnetic core make may turn into an obtuse angle, improvement in effectiveness can be aimed at.
[0019] (Drawing 8) Form the pole by patterning after forming the magnetic film for the poles by

a spatter etc.
[0020] SB cut is carried out and a head is completed through chip-izing, an assembly process, etc.
[0021] In order to connect with a core in the through hole part which formed the pole part of the vertical-magnetic-recording mold thin film magnetic head on the insulating layer of the minute thickness formed on the core and the embedded insulating layer, and was formed on the core according to the above structure and the process, The membraneous quality of the insulating layer of a core / insulating material boundary, and the partial wear of the core material at the time of smoothing, and an insulating material, Without being influenced by the level difference of the core / insulating interface section by the difference of an etching rate etc., the magnetic film for the poles can be formed and dependability and the high vertical-magnetic-recording mold thin film magnetic head of a yield can be offered.
[0022] Although explanation of this example explained the case where the laminating of a magnetic core and the pole was carried out on a magnetic substrate at abbreviation parallel, as shown in drawing 9 , also when forming a magnetic core and the pole in an abbreviation perpendicular to a magnetic substrate, it cannot be overemphasized that the same effectiveness is acquired. Moreover, although explanation of this example explained the case where the Mn-Zn ferrite of a magnetic substrate was used, also when a magnetic film is formed on a substrate, it cannot be overemphasized that the same effectiveness is acquired. Moreover, by using a nickel-Zn ferrite for a magnetic substrate, the insulating stratification between a substrate/coil becomes unnecessary, and can aim at compaction of a manufacture process.
[0023] the top view and drawing 11 which show the 2nd example of the thin film magnetic head according [drawing 10] to this invention -- the B-B' sectional view of drawing 10 , and drawing 12 -- the enlarged drawing of the pole part of drawing 11 -- it is -- 1 -- a magnetic substrate and 2 -- for a signal coil and 7, as for the main pole and 8, a magnetic core and 11 are [a nonmagnetic insulating substrate and 4 / a signal coil insulation layer and 5 / a protective coat and 13] auxiliary magnetic poles.
[0024] The Mn-Zn ferrite substrate is used for the magnetic substrate 1 in this example. The Co-Ta-Zr system amorphous alloy is formed in magnetic-core material by sputtering etc. The signal coil forms Cu by vacuum evaporationo etc. by making Cr into a junctional zone. Forsterite is formed in a protective coat by sputtering, vacuum evaporationo, etc.
[0025] Hereafter, the production process of the thin film magnetic head by this invention is met and explained to drawing 13 - drawing 21 .
[0026] (drawing 13) the coil which consists of Cr/Cu/Cr (Cr; junctional zone) after forming the nonmagnetic insulating layer of SiO2 and aluminum2O3 grade by sputtering etc. to the magnetic substrate 1 -- form the core connection through hole 6 after forming a conductor 5 through a coil insulation layer.
[0027] (Drawing 14) By sputtering etc., carry out a core connection through hole embedded ** flattening with a magnetic film with the etchback according a Co-Ta-Zr system amorphous alloy to membrane formation, mechanical polish, and ion etching etc., and form a pole connection and the auxiliary magnetic pole 13.
[0028] (drawing 15) the nonmagnetic insulating substrate 2 -- a dicer, ion etching, etc. -- core embedded -- form the slot on the business and form a Co-Ta-Zr system amorphous alloy by sputtering etc.
[0029] (Drawing 16) Carry out flattening with the etchback by mechanical polish or ion etching etc. so that a magnetic film may remain minute film thickness on a nonmagnetic substrate.
[0030] (Drawing 17) Remove the magnetic film on a nonmagnetic substrate.
[0031] At this time, if it forms so that a nonmagnetic insulating substrate and the angle theta which the upper magnetic film makes may turn into an obtuse angle, improvement in effectiveness can be aimed at.
[0032] (Drawing 18) By sputtering etc., form membranes, carry out patterning of the magnetic film for the main poles, and form the pole 11.
[0033] (Drawing 19) Cut into SB condition the component formed on the magnetic substrate.
[0034] (Drawing 20) The pole formed on the nonmagnetic substrate graduates a part for pole jointing with a lap etc., after carrying out SB cut.

[0035] (Drawing 21) To the optimal component height, with a lap etc. and adhesion and after carrying out Gd control, sheet-metal-ize sheet-metal-izing and a nonmagnetic substrate part with a lap etc., so that it may be combined magnetically and the pole on the magnetic substrate component of SB condition and a nonmagnetic insulating substrate may be interlocked. [a magnetic substrate] A head is completed through chip-izing, an assembly process, etc.
[0036] In order to form a pole point in the through hole part which formed the pole part of the vertical-magnetic-recording mold thin film magnetic head on the magnetic layer of the minute thickness on a nonmagnetic substrate and an embedded core, and was formed on the nonmagnetic substrate according to the above structure and the process, The membraneous quality of the magnetic layer of a core / nonmagnetic insulating-substrate boundary, and core material at the time of smoothing and partial wear of a nonmagnetic insulating substrate, Without being influenced by the level difference of the core / insulating interface section by the difference of an etching rate etc., the magnetic film for the poles can be formed and dependability and the high vertical-magnetic-recording mold thin film magnetic head of a yield can be offered.
[0037] Although explanation of this example explained the case where the pole was constituted to an abbreviation perpendicular direction in the core of a coil coil, as shown in drawing 22 , it cannot be overemphasized that effectiveness with the same said of the case where the point of the component formed on the magnetic substrate is pasted in the cross section of the magnetic substrate used as the pole membrane formation side formed on the nonmagnetic insulating substrate and a magnetic core is acquired. Moreover, although explanation of this example explained the case where the Mn-Zn ferrite of a magnetic substrate was used, also when a magnetic film is formed on a substrate, it cannot be overemphasized that the same effectiveness is acquired. Moreover, by using a nickel-Zn ferrite for a magnetic substrate, the insulating stratification between a substrate/coil becomes unnecessary, and can aim at compaction of a manufacture process. Moreover, although explanation of the 1st and 2nd example was explained by the case where the main magnetic path is a magnetic substrate, also when the magnetic core used as the main magnetic path is used as the magnetic layer on a substrate, and the magnetic layer to which the main magnetic path penetrates the inside of a coil coil, it cannot be overemphasized that the same effectiveness is acquired. Although furthermore explained by this invention in the form which embedded the magnetic film at the nonmagnetic substrate which forms the magnetic film for the poles, it cannot be overemphasized that the same effectiveness can be acquired also with the structure which embedded the nonmagnetic membrane at the magnetic substrate and formed the magnetic film for the poles as shown in drawing 23 . Moreover, it cannot be overemphasized that magnetic-flux leakage in the coil section can be reduced by embedding a nonmagnetic membrane at a magnetic substrate etc., and the still more efficient vertical magnetic head can be obtained.
[0038]
[Effect of the Invention] As explained above, according to this invention, the pole film of the thin film vertical magnetic head is formed on the insulating layer of the minute thickness formed on the core and the embedded insulating layer. By forming the pole film on the magnetic film of the minute thickness which connected with the core in the through hole part formed on the core, or was formed on the core and the embedded insulating layer Since the upper insulating layer or a magnetic layer covers the level difference of the core / insulating interface section by the membraneous quality of the insulating layer of a core / insulating material boundary and the partial wear of the core material at the time of smoothing, and an insulating material, the difference of an etching rate, etc., The magnetic film for the poles can be formed to a good smooth side, and dependability and the high vertical-magnetic-recording mold thin film magnetic head of a yield can be offered.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the top view showing an example of the thin film magnetic head by this invention.
[Drawing 2] It is the A-A' sectional view of drawing 1 .
[Drawing 3] It is production process drawing explaining an example of the thin film magnetic head by this invention.
[Drawing 4] Similarly it is production process drawing.
[Drawing 5] Similarly it is production process drawing.
[Drawing 6] Similarly it is production process drawing.
[Drawing 7] Similarly it is production process drawing.
[Drawing 8] Similarly it is production process drawing.
[Drawing 9] It is the sectional view showing the example of others of this invention.
[Drawing 10] It is the top view showing the 2nd example of the thin film magnetic head by this invention.
[Drawing 11] It is the B-B' sectional view of drawing 10 .
[Drawing 12] It is the pole section enlarged drawing of drawing 11 .
[Drawing 13] It is production process drawing explaining the 2nd example of the thin film magnetic head by this invention.
[Drawing 14] Similarly it is production process drawing.
[Drawing 15] Similarly it is production process drawing.
[Drawing 16] Similarly it is production process drawing.
[Drawing 17] Similarly it is production process drawing.
[Drawing 18] Similarly it is production process drawing.
[Drawing 19] Similarly it is production process drawing.
[Drawing 20] Similarly it is production process drawing.
[Drawing 21] Similarly it is production process drawing.
[Drawing 22] It is the sectional view showing the example of others of this invention.
[Drawing 23] It is the sectional view showing other examples similarly.
[Drawing 24] It is drawing showing the conventional vertical recording mold thin film magnetic head.
[Drawing 25] It is drawing showing the thin film magnetic head similarly.
[Drawing 26] It is drawing showing the thin film magnetic head similarly.
[Drawing 27] It is drawing showing the thin film magnetic head similarly.
[Drawing 28] It is drawing showing the thin film magnetic head similarly.
[Description of Notations]
1 -- Magnetic substrate,
2 -- Nonmagnetic substrate,
3 -- Insulating layer,
4 -- Signal coil insulation layer,
5 -- Signal coil
6 -- Core connection,
7 -- Magnetic core
8 -- Protective coat,

11 — Main pole,
13 — Auxiliary magnetic pole.

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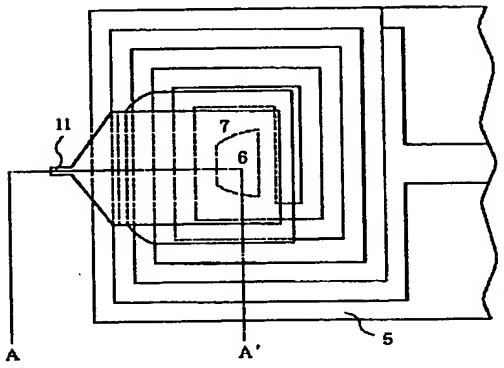
DRAWINGS

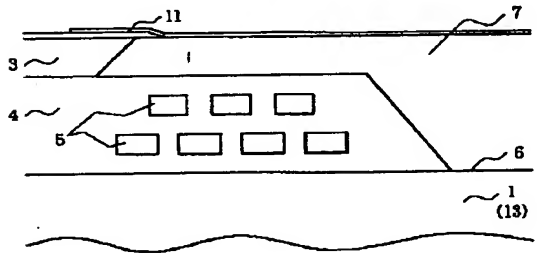
[Drawing 1]

図1



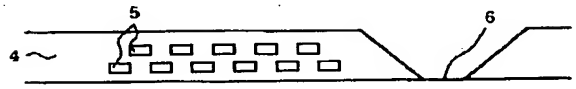
[Drawing 2]

図2



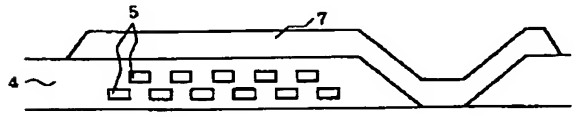
[Drawing 3]

図3



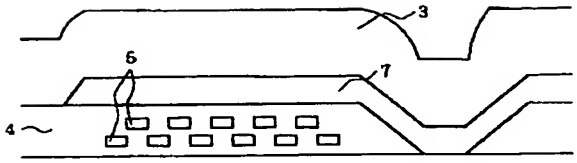
[Drawing 4]

図4



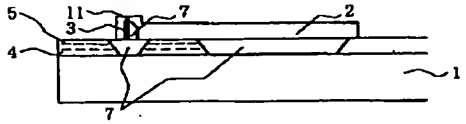
[Drawing 5]

図5



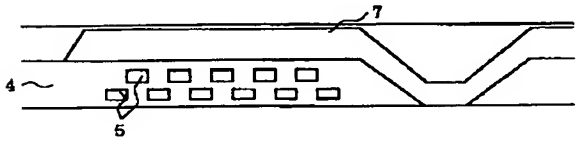
[Drawing 11]

図11



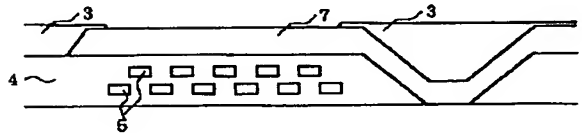
[Drawing 6]

図6



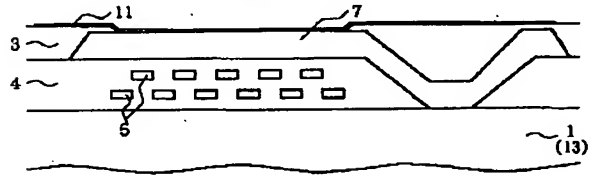
[Drawing 7]

図7



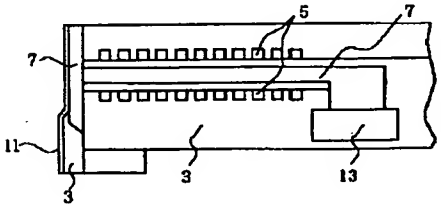
[Drawing 8]

図8



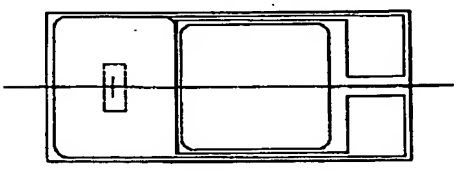
[Drawing 9]

図9



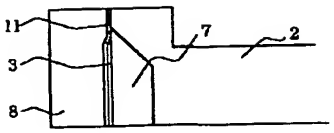
[Drawing 10]

図10



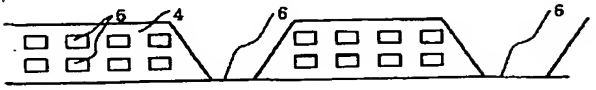
[Drawing 12]

図１２



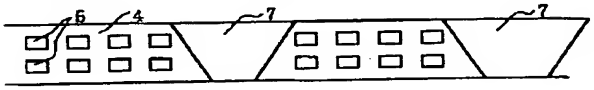
[Drawing 13]

図１３



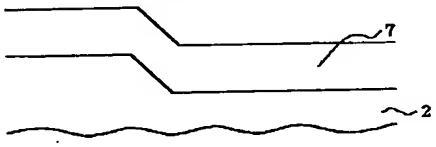
[Drawing 14]

図１４



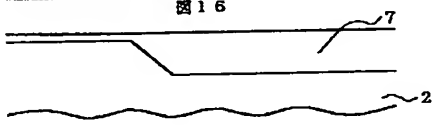
[Drawing 15]

図１５



[Drawing 16]

図１６



[Drawing 17]

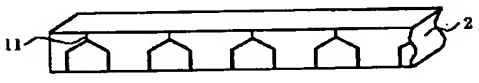
図１７

[Drawing 18]

図１８

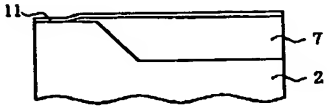
[Drawing 19]

図１９



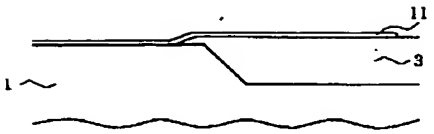
[Drawing 20]

図２０



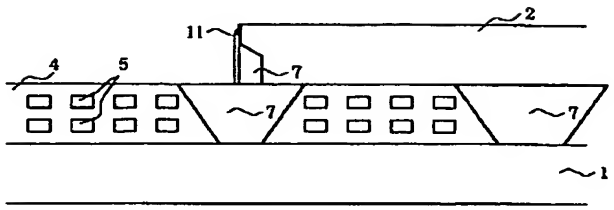
[Drawing 23]

図２３



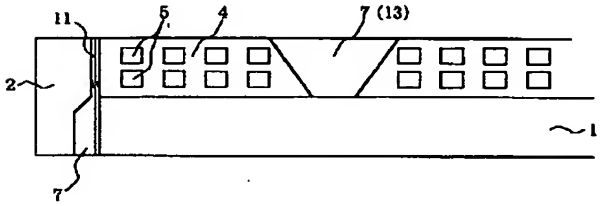
[Drawing 21]

図２１



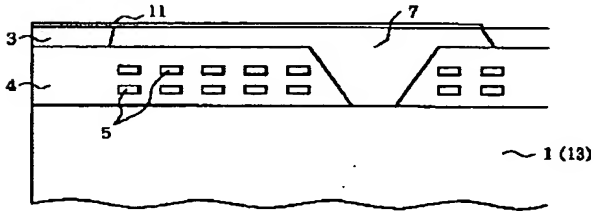
[Drawing 22]

図２２



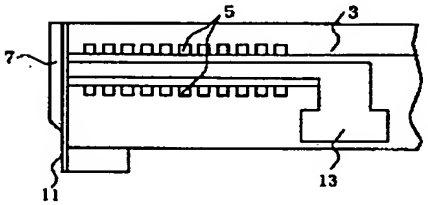
[Drawing 24]

図２４



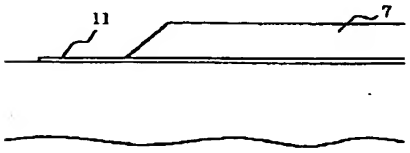
[Drawing 25]

図２５



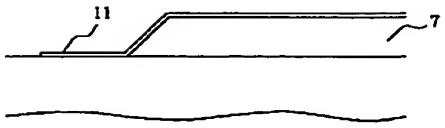
[Drawing 26]

図２６



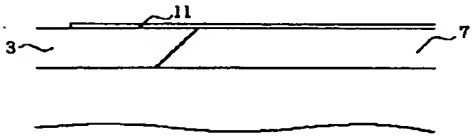
[Drawing 27]

図２７



[Drawing 28]

図２８



[Translation done.]

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最終頁に続く

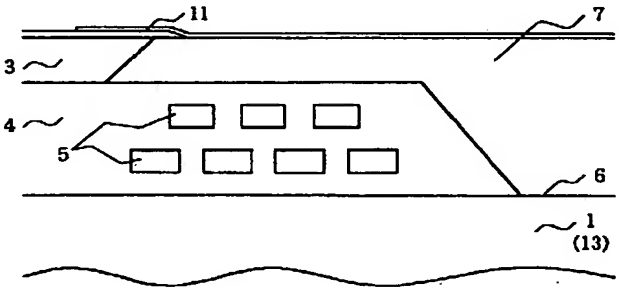
(54)【発明の名称】　垂直磁気記録型薄膜磁気ヘッド

(57)【要約】

【目的】本発明の目的は、ヘッドの微小、軽量化、ヘッド素子高さを最小にできる薄膜垂直磁気ヘッドのポール膜形成において、信頼性、歩留の向上を得る薄膜垂直磁気ヘッドを提供することにある。

【構成】上記目的は、垂直磁気記録型薄膜磁気ヘッドのポール部分をコアおよび埋込絶縁層上に形成された微小膜厚の絶縁層上に形成し、コア上に形成したスルーホール部分でコアと接続するか、もしくはコアおよび埋込絶縁層上に形成された微小膜厚の磁性膜上にポール膜を成膜することにより達成される。

図２



ッドの微小、軽量化が図れ、また上記磁気コア／主磁極の２面構造は、ヘッド素子高さを小さくできる点等で優位である。しかしながら、ポール形成プロセスにおいて、ポールとコアの関係が図２６の様な場合、平滑面上にポール膜を成膜することは可能であるが、上部コアパターニング時に、ポール膜が損傷を受けるという問題があった。また、図２７の様な場合コアの段差上にポール膜を成膜するため、段差部での膜厚、膜質の信頼性に問題があった。さらに、図２８に示す様な構造をとると、主磁極と補助磁極の間隔が大きくとれ、コアの段差上への成膜も無く、コアのエッチングによるポールパターンの損傷等も無いが、コアパターンと埋込絶縁層の境界部分の絶縁層の膜質および平滑化時のコア材と絶縁材の偏摩耗、エッチングレイトの差等によりコア／絶縁層境界部に微小ながら段差を生じる。一方、上層に成膜するポール膜は、その膜厚が非常に薄い（～０．３μｍ）ために微小な段差にも影響されてしまい、ポールの損傷を招き、歩留まり、信頼性に問題があった。

【０００６】本発明の目的は、ヘッドの微小、軽量化、ヘッド素子高さを最小にできる薄膜垂直磁気ヘッドのポール膜形成において、信頼性、歩留の向上を得る薄膜垂直磁気ヘッドを提供することにある。

【０００７】

【課題を解決するための手段】上記目的は、垂直磁気記録型薄膜磁気ヘッドのポール部分をコアおよび埋込絶縁層上に形成された微小膜厚の絶縁層上に形成し、コア上に形成したスルーホール部分でコアと接続するか、もしくはコアおよび埋込絶縁層上に形成された微小膜厚の磁性膜上にポール膜を成膜することにより達成される。

【０００８】

【作用】薄膜垂直磁気ヘッドのポール膜をコアおよび埋込絶縁層上に形成された微小膜厚の絶縁層上に形成し、コア上に形成したスルーホール部分でコアと接続するか、もしくはコアおよび埋込絶縁層上に形成された微小膜厚の磁性膜上にポール膜を成膜することにより、コア／絶縁材境界の絶縁層の膜質および平滑化時のコア材と絶縁材の偏摩耗、エッチングレイトの差等によるコア／絶縁層境界部の段差を上層の絶縁層、もしくは磁性層がカバーするため、良好な平滑面にポール用磁性膜を成膜することができ、信頼性、歩留の高い垂直磁気記録型薄膜磁気ヘッドを提供することができる。

【０００９】

【実施例】以下、本発明の第１の実施例を図面を用いて説明する。

【００１０】図１は本発明による薄膜磁気ヘッドの一例を示す平面図、図２は図１のＡ－Ａ’断面図であって、１は磁性基板、２は非磁性絶縁基板、４は信号コイル絶縁層、５は信号コイル、７は磁気コア、１１は主磁極、８は保護膜、１３は補助磁極である。

【００１１】本実施例では磁性基板１にＭｎ－Ｚｎフェライト基板を用いている。磁気コア材にはＣｏ－Ｔａ－Ｚｒ系アモルファス合金をスパッタリング等により形成している。信号コイルはＣｒを接合層としてＣｕを蒸着等により形成している。保護膜には、フォルステライトをスパッタリングや蒸着等により形成している。

【００１２】以下、本発明による薄膜磁気ヘッドの製造工程を図３～図８にそって説明する。

【００１３】（図３）磁性基板１にSiO_2，Al_2O_3等の非磁性絶縁層をスパッタリング等により成膜した後、Ｃｒ／Ｃｕ／Ｃｒ（Ｃｒ；接合層）から成るコイル導体５をコイル絶縁層を介して形成した後、コア接続スルーホール６を形成する。

【００１４】（図４）Ｃｏ－Ｔａ－Ｚｒ系アモルファス合金をスパッタリング等により成膜、パターニングして、磁気コア７を形成する。

【００１５】（図５）フォルステライト等の非磁性絶縁材をスパッタ等で成膜する。

【００１６】（図６）機械的研磨による平坦化ラップやイオンエッチングによるエッチバック等により、コア上に絶縁層が残る様に平坦化する。

【００１７】（図７）コア上の微小膜厚の非磁性絶縁層を除去する。

【００１８】この時、非磁性絶縁層と磁気コアのなす角θが鈍角となるように形成すると効率の向上を図ることができる。

【００１９】（図８）ポール用の磁性膜をスパッタ等により成膜した後、パターニングによりポールを形成する。

【００２０】ＳＢカットして、チップ化、組立て工程等をへて、ヘッドが完成する。

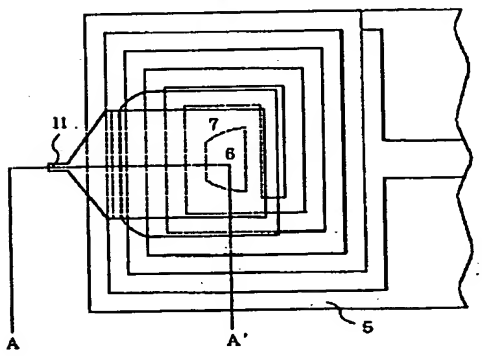
【００２１】以上の構造、製法によれば、垂直磁気記録型薄膜磁気ヘッドのポール部分をコアおよび埋込絶縁層上に形成された微小膜厚の絶縁層上に形成し、コア上に形成したスルーホール部分でコアと接続するため、コア／絶縁材境界の絶縁層の膜質および平滑化時のコア材と絶縁材の偏摩耗、エッチングレイトの差等によるコア／絶縁層境界部の段差に影響されること無く、ポール用磁性膜を成膜することができ信頼性、歩留の高い垂直磁気記録型薄膜磁気ヘッドを提供することができる。

【００２２】本実施例の説明では、磁性基板上に磁気コア、ポールを略平行に積層した場合について説明したが、図９に示すように磁気コアおよびポールを磁性基板に対して略垂直に形成する場合も同様の効果を得ることは言うまでもない。また、本実施例の説明では磁性基板のＭｎ－Ｚｎフェライトを用いた場合について説明したが、基板上に磁性膜を形成した場合にも同様の効果を得ることはいうまでもない。また、磁性基板にＮｉ－Ｚｎフェライトを用いることで、基板／コイル間の絶縁層形成が不用となり、製造プロセスの短縮を図ることができる。

【図３】本発明による薄膜磁気ヘッドの一例を説明する製造工程図である。
【図４】同じく製造工程図である。
【図５】同じく製造工程図である。
【図６】同じく製造工程図である。
【図７】同じく製造工程図である。
【図８】同じく製造工程図である。
【図９】本発明のその他の例を示す断面図である。
【図１０】本発明による薄膜磁気ヘッドの第２の実施例を示す平面図である。
【図１１】図１０のＢ－Ｂ’断面図である。
【図１２】図１１のポール部拡大図である。
【図１３】本発明による薄膜磁気ヘッドの第２の実施例を説明する製造工程図である。
【図１４】同じく製造工程図である。
【図１５】同じく製造工程図である。
【図１６】同じく製造工程図である。
【図１７】同じく製造工程図である。
【図１８】同じく製造工程図である。
【図１９】同じく製造工程図である。
【図２０】同じく製造工程図である。
【図２１】同じく製造工程図である。
【図２２】本発明のその他の例を示す断面図である。
【図２３】同じくその他の例を示す断面図である。
【図２４】従来の垂直記録型薄膜磁気ヘッドを示す図である。
【図２５】同じく薄膜磁気ヘッドを示す図である。
【図２６】同じく薄膜磁気ヘッドを示す図である。
【図２７】同じく薄膜磁気ヘッドを示す図である。
【図２８】同じく薄膜磁気ヘッドを示す図である。
【符号の説明】
１…磁性基板、
２…非磁性基板、
３…絶縁層、
４…信号コイル絶縁層、
５…信号コイル、
６…コア接続部、
７…磁気コア、
８…保護膜、
１１…主磁極、
１３…補助磁極。

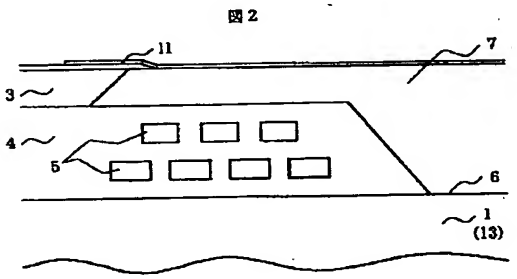
【図１】

図1



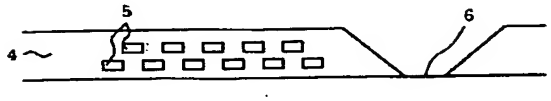
【図２】

図2



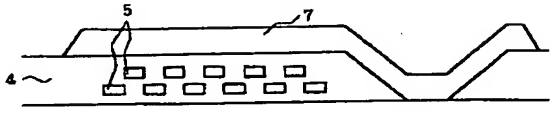
【図３】

図3



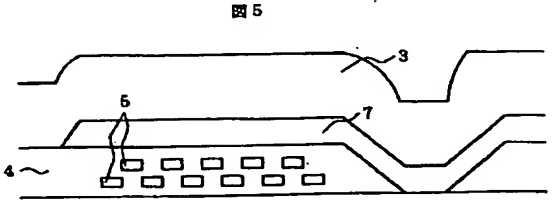
【図４】

図4



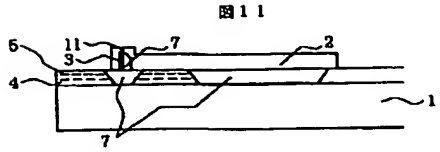
【図５】

図5



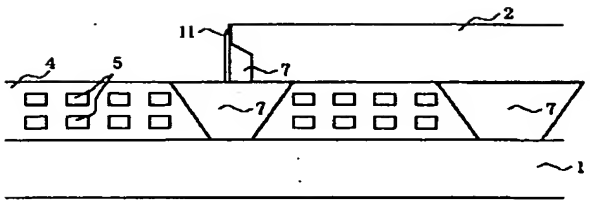
【図１１】

図11



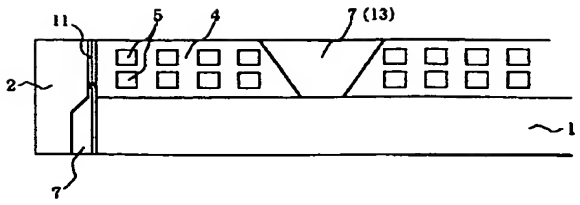
【図２１】

図２１



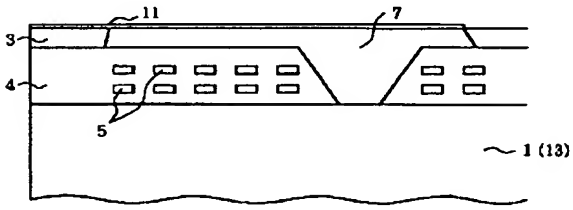
【図２２】

図２２



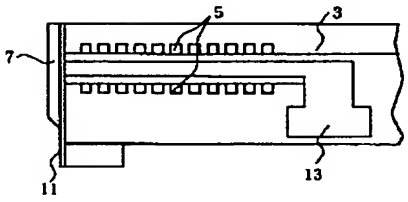
【図２４】

図２４



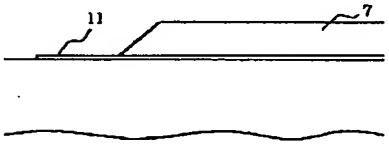
【図２５】

図２５



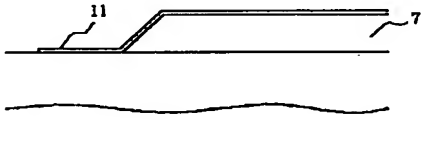
【図２６】

図２６



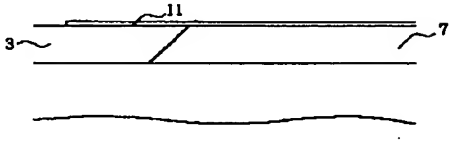
【図２７】

図２７



【図２８】

図２８



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